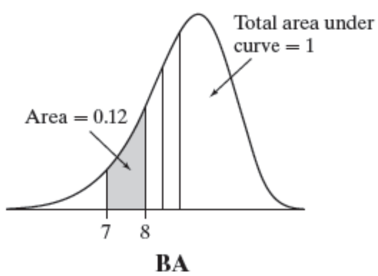
Section 2.2

Check Your Understanding, page 107:

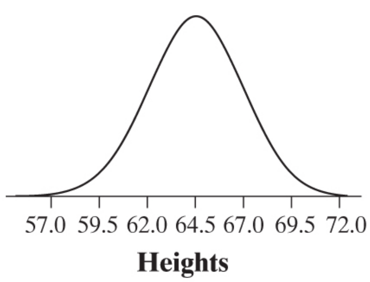
1. It is legitimate because it is positive everywhere and it has total area under the curve = 1.
2. About 12% of the observations lie between 7 and 8.
3. Point A in the graph below is the approximate median. About half of the area is to the left of A and half of the area is to the right of A.



4. Point B in the graph above is the approximate mean (balance point). The mean is less than the median in this case because the distribution is skewed to the left.

Check Your Understanding, page 112:

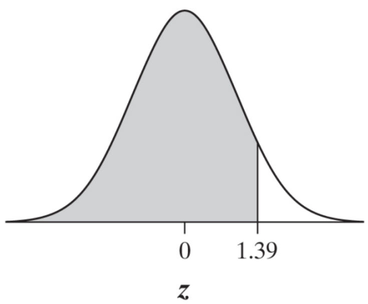
1. The graph is shown below:



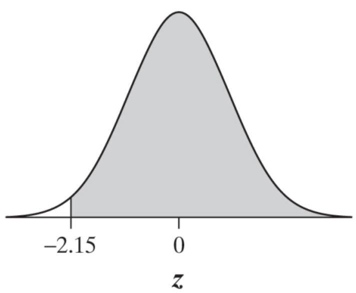
2. Because 67 inches is one standard deviation above the mean, approximately $\frac{100\% - 68\%}{2} = 16\%$ of young women have heights greater than 67 inches.
3. Because 62 is one standard deviation below the mean approximately $\frac{100\% - 68\%}{2} = 16\%$ have heights below 62 inches. Because 72 is three standard deviations above the mean, approximately $\frac{100\% - 99.7\%}{2} = 0.15\%$ of young women have heights above 72 inches. The remaining 83.85% (100% – 16% – 0.15%) have heights between 62 and 72 inches.

Check Your Understanding, page 116:

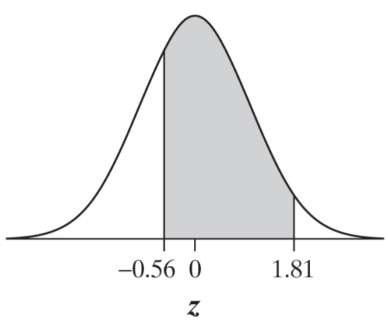
1. The proportion is 0.9177. A graph is shown below:



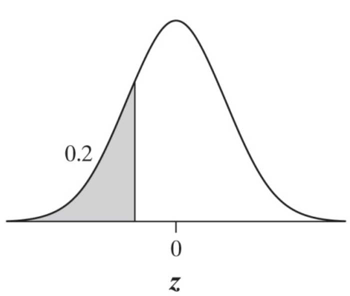
2. The proportion is 0.9842. A graph is shown below:



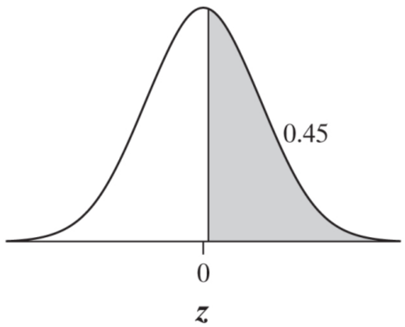
3. The proportion is $0.9649 - 0.2877 = 0.6772$. A graph is shown below:



4. The z-score for the 20th percentile is $z = -0.84$. A graph is shown below:

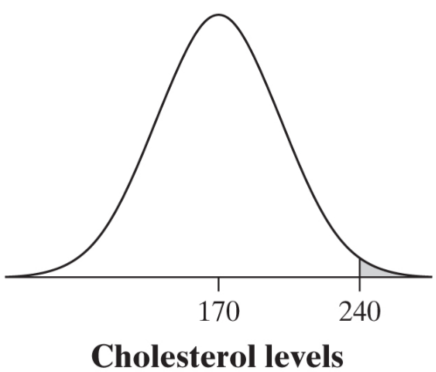


5. If 45% of the observations are greater than z, then 55% of the observations are less than or equal to z. The z-score for the 55^{th} percentile is $z = 0.13$. A graph is shown below:

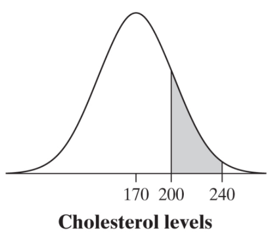


Check Your Understanding, page 121:

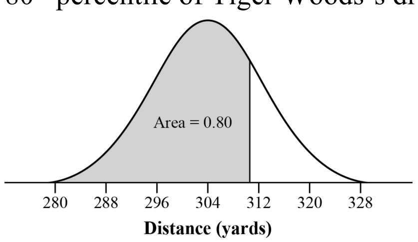
1. **Step 1: State the distribution and values of interest.** For 14-year-old boys, the amount of cholesterol follows a Normal distribution with mean 170 and standard deviation 30. We want to find the percent of boys with cholesterol of more than 240 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{240 - 170}{30} = 2.33$. From Table A, the proportion of z-scores above 2.33 is 1 – 0.9901 = 0.0099. *Using technology:* The command normalcdf(lower: 240, upper: 1000, μ: 170, σ: 30) gives an area of 0.0098. **Step 3: Answer the question.** About 1% of 14-year-old boys have cholesterol above 240 mg/dl.



2. **Step 1: State the distribution and values of interest.** For 14-year-old boys, the amount of cholesterol follows a Normal distribution with mean 170 and standard deviation 30. We want to find the percent of boys with cholesterol between 200 and 240 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary values are $z = \frac{200-170}{30} = 1$ and $z = \frac{240-170}{30} = 2.33$. From Table A, the proportion of z-scores below $z = 1.00$ is 0.8413 and the proportion of z-scores below 2.33 is 0.9901. Thus, the proportion of z-scores between 1 and 2.33 is 0.9901 – 0.8413 = 0.1488. *Using technology:* The command normalcdf(lower: 200, upper: 240, μ: 170, σ: 30) gives an area of 0.1488. **Step 3: Answer the question.** About 15% of 14-year-old boys have cholesterol between 200 and 240 mg/dl.

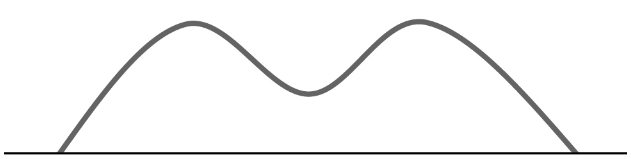


3. **Step 1: State the distribution and values of interest.** For Tiger Woods, the distance his drives travel follows a Normal distribution with mean 304 and standard deviation 8. The 80^{th} percentile is the boundary value x with 80% of the distribution to its left (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for a value closest to 0.80. A z-score of 0.84 gives the closest value (0.7995). Solving $0.84 = \frac{x-304}{8}$ gives $x = 310.7$. *Using technology:* The command invNorm(area: 0.8, μ: 304, σ: 8) gives a value of 310.7. **Step 3: Answer the question.** The 80^{th} percentile of Tiger Woods's drive lengths is about 310.7 yards.

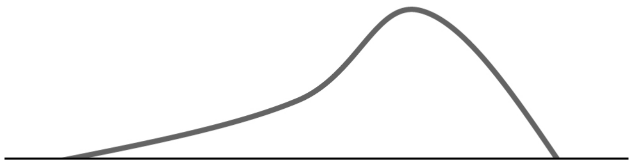


Exercises, page 128:

2.33 Sketches will vary, but here is one example:



2.34 Sketches will vary, but here is one example:



2.35 (a) It is on or above the horizontal axis everywhere, and the area beneath the curve is $\frac{1}{3} \times 3 = 1$.

(b) This is a $\frac{1}{3}$ by 1 rectangle, so the area (proportion) is $\frac{1}{3} \times 1 = \frac{1}{3}$.

(c) Because 1.1 – 0.8 = 0.3, this is a $\frac{1}{3}$ by 0.3 rectangle, so the proportion is $\frac{1}{3} \times 0.3 = 0.1$.

2.36 (a) It is on or above the horizontal axis everywhere, and the area beneath the curve is $\frac{1}{10} \times 10 = 1$.

(b) Because 10 – 8 = 2, this is a 1/10 by 2 rectangle, so the percent is $\frac{1}{10} \times 2 = 0.2 = 20\%$.

(c) Because 5.3 – 2.5 = 2.8, this is a 1/10 by 2.8 rectangle, so the percent is $\frac{1}{10} \times 2.8 = 0.28 = 28\%$.

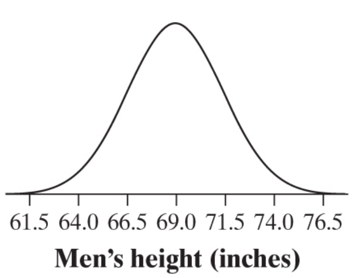
2.37 Both are 1.5. The mean is 1.5 because the balance point of a symmetric density curve is exactly in the middle. The median is also 1.5 because half of the area lies to the left of 1.5 and half to the right of 1.5.

2.38 Both are 5. The mean is 5 because the balance point of a symmetric density curve is exactly in the middle. The median is also 5 because half of the area lies to the left of 5 and half to the right of 5.

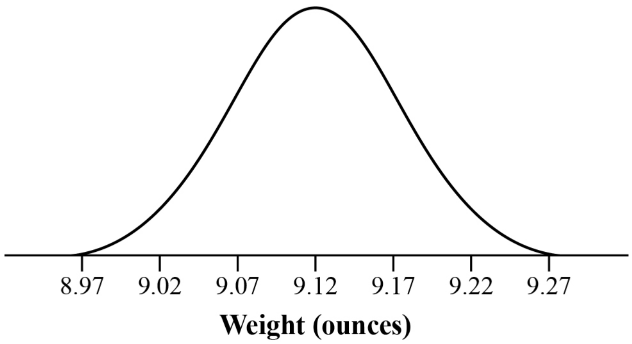
2.39 (a) Mean is C, median is B (the right skew pulls the mean to the right of the median).
(b) Mean is B, median is B (this distribution is symmetric, so mean = median).

2.40 (a) Mean is A, median is A (the distribution is symmetric, so mean = median).
(b) Mean A, median B (the left skew pulls the mean to the left of the median).

2.41 The Normal density curve with mean 69 and standard deviation 2.5 is shown below.



2.42 The Normal density curve with mean 9.12 and standard deviation 0.05 is shown below.



2.43 (a) Approximately 95% of men have heights within 2 standard deviations of the mean. That is, between 69 – 2(2.5) = 64 and 69 + 2(2.5) = 74 inches.

(b) 74 inches is two standard deviations above the mean, so approximately $\frac{100\% - 95\%}{2}$ = 2.5% of men are taller than 74 inches.

(c) Approximately $\frac{100\% - 68\%}{2}$ = 16% of men are shorter than 66.5 inches, because 66.5 is one standard deviation below the mean. Approximately $\frac{100\% - 95\%}{2}$ = 2.5% are shorter than 64 inches, because 64 inches is two standard deviations below the mean. So, approximately $16\% - 2.5\% = 13.5\%$ of men have heights between 64 inches and 66.5 inches.

(d) The value 71.5 is one standard deviation above the mean. Because $\frac{100\% - 68\%}{2}$ = 16% of the area is to the right of 71.5, 100% – 16% = 84% of the area is to the left of 71.5. Thus, a height of 71.5 is at the 84th percentile of adult male American heights.

2.44 (a) Approximately 68% of bags have weights within 1 standard deviation of the mean. That is, between $9.12 - 0.05 = 9.07$ ounces and $9.12 + 0.05 = 9.17$ ounces.

(b) 9.02 is two standard deviations below the mean, so approximately $\frac{100 - 95}{2}$ = 2.5% of bags weigh less than 9.02 ounces.

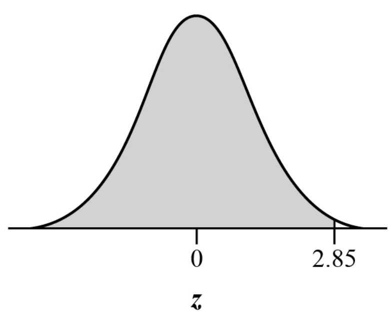
(c) Approximately 100% – $\frac{100\% - 68\%}{2}$ = 100% – 16% = 84% of bags have weights less than 9.17 ounces, because 9.17 is one standard deviation above the mean. Approximately $\frac{100\% - 99.7\%}{2}$ = 0.15% of bags have weight less than 8.97 ounces, because 8.97 is three standard deviations below the mean. So, approximately $84\% - 0.15\% = 83.85\%$ of bags have weights between 8.97 and 9.17 ounces.

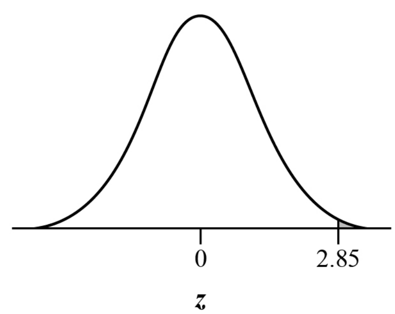
(d) The value 9.07 is one standard deviation below the mean. Approximately $\frac{100\% - 68\%}{2}$ = 16% of the bags weigh less than 9.07 ounces. In other words, 9.07 is the 16th percentile of the weights of these potato chip bags.

2.45 Approximately 95% of the values for the taller curve are between –0.4 and 0.4, so the standard deviation is approximately 0.2. Approximately 95% of the values for the shorter curve are between –1 and 1, so the standard deviation is approximately 0.5. These values can also be obtained by finding the inflection points on each curve and estimating the horizontal distance between the inflection point and the mean.

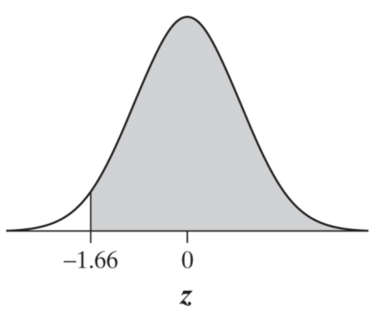
2.46 The mean is approximately 10. Because approximately 95% of the values are between 6 and 14, the standard deviation is about 2. This value can also be obtained by finding the inflection point and estimating the horizontal distance between the inflection point and the mean.

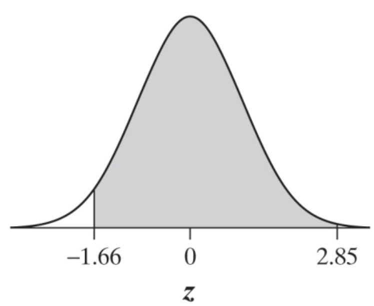
2.47 (a) 0.9978. The graph is shown below (left). (b) 1 − 0.9978 = 0.0022. The graph is shown below (right).



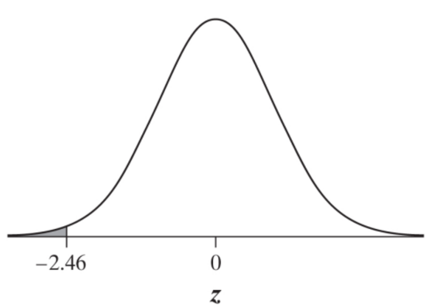


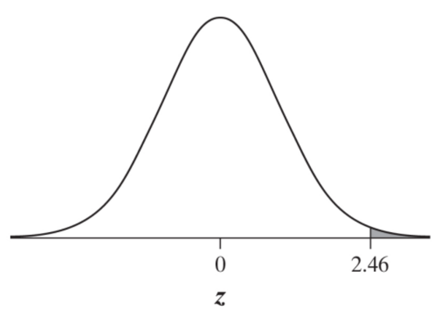
(c) 1 – 0.0485 = 0.9515. The graph is shown below (left). (d) 0.9978 – 0.0485 = 0.9493. The graph is show below (right).



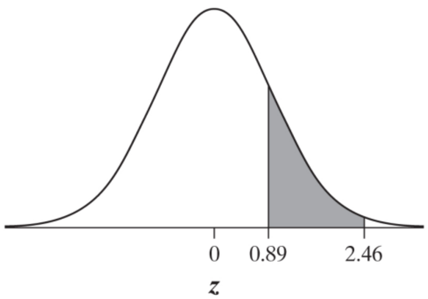


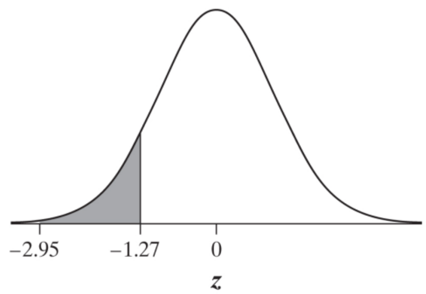
2.48 (a) 0.0069. The graph is shown below (left). (b) 1 − 0.9931 = 0.0069. The graph is shown below (right).



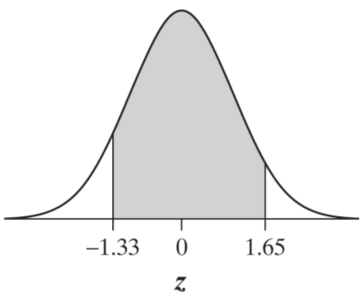


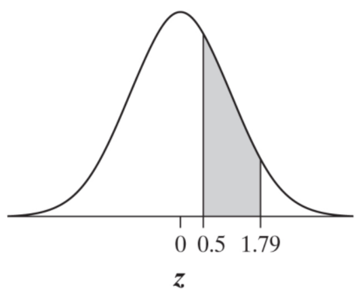
(c) 0.9931 − 0.8133 = 0.1798. The graph is shown below (left). (d) 0.1020 − 0.0016 = 0.1004. The graph is shown below (right).



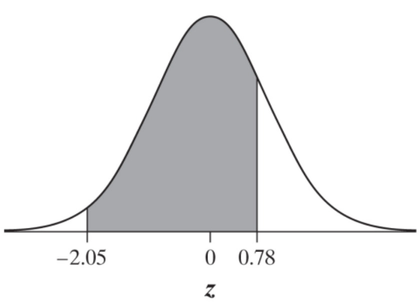


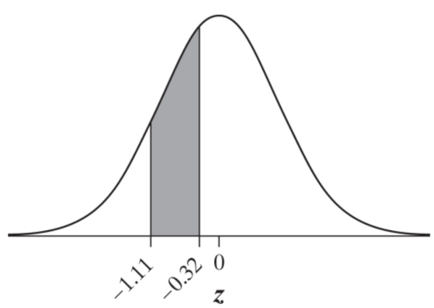
2.49 (a) 0.9505 – 0.0918 = 0.8587. The graph is shown below (left). (b) 0.9633 – 0.6915 = 0.2718. The graph is shown below (right).



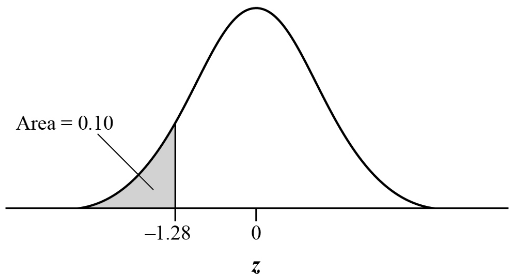


2.50 (a) 0.7823 – 0.0202 = 0.7621. The graph is shown below (left). (b) 0.3745 – 0.1335 = 0.2410. The graph is shown below (right).

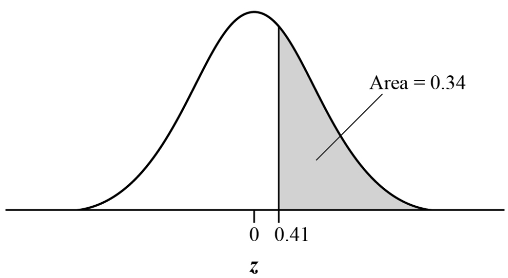




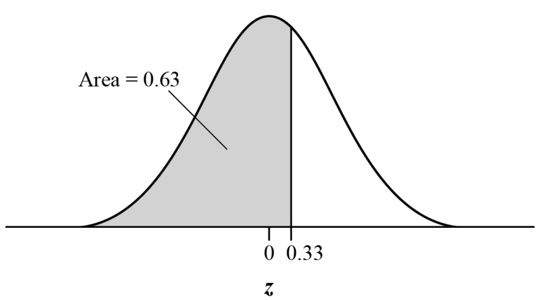
2.51 (a) The value that is closest to 0.1000 in Table A is 0.1003. This corresponds to a value of -1.28 for z.



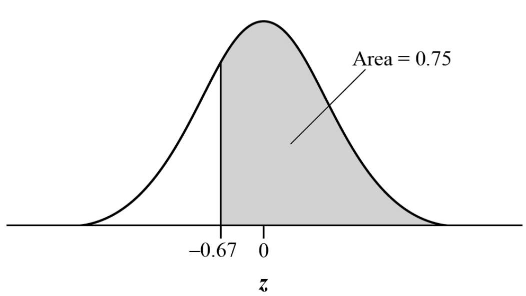
(b) The point where 34% of observations are greater is also the $100-34=66^{\text{th}}$ percentile. The value that is closest to 0.6600 in Table A is 0.6591, which corresponds to a z-score of 0.41.



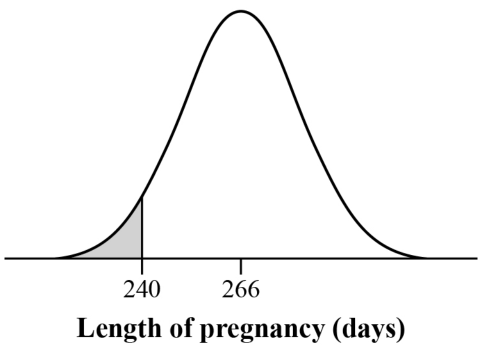
2.52 (a) The value that is closest to 0.6300 in Table A is 0.6293, which corresponds to a z-value of 0.33.



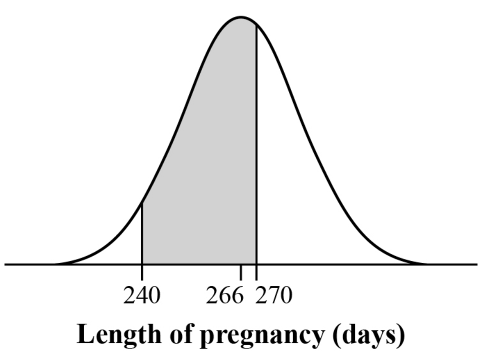
(b) If 75% of values are greater than z, then 25% are lower. The value that is closest to 0.2500 in Table A is 0.2514, which corresponds to a z-score of –0.67.



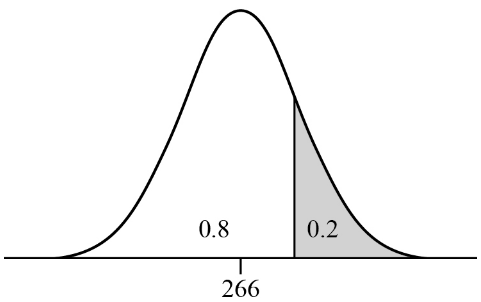
2.53 (a) **Step 1: State the distribution and values of interest.** The length of pregnancies follows a Normal distribution with $\mu = 266$ days and $\sigma = 16$ days. We want the proportion of pregnancies that last less than 240 days (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{240 - 266}{16} = -1.63$. From Table A, the proportion of *z*-scores less than –1.63 is 0.0516. *Using technology:* The command normalcdf(lower: –1000, upper: 240, μ: 266, σ: 16) gives an area of 0.0521. **Step 3: Answer the question.** About 5% of pregnancies last less than 240 days, so 240 days is at the 5th percentile of pregnancy lengths.



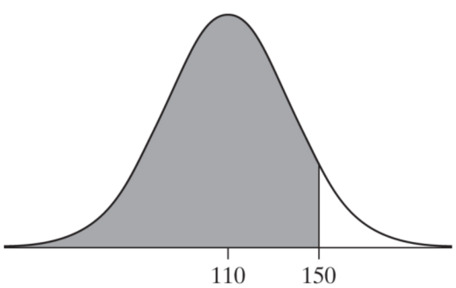
(b) **Step 1: State the distribution and values of interest.** The length of pregnancies follows a Normal distribution with $\mu = 266$ days and $\sigma = 16$ days. We want the proportion of pregnancies that last between 240 and 270 days (see graph below). **Step 2: Perform calculations. Show your work.** The standardized scores for the boundary values are $z = \frac{240 - 266}{16} = -1.63$ and $z = \frac{270 - 266}{16} = 0.25$. From Table A, the proportion of *z*-scores less than –1.63 is 0.0516 and the proportion of *z*-scores less than 0.25 is 0.5987. Thus, the proportion of *z*-scores between –1.63 and 0.25 is 0.5987 – 0.0516 = 0.5471. *Using technology:* The command normalcdf(lower: 240, upper: 270, μ: 266, σ: 16) gives an area of 0.5466. **Step 3: Answer the question.** About 55% of pregnancies last between 240 and 270 days.



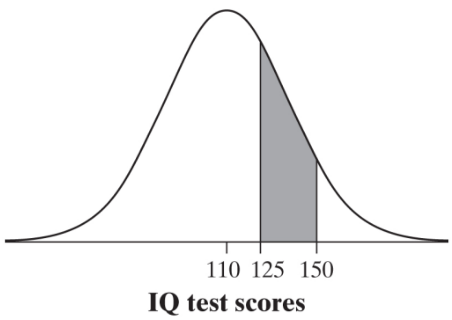
(c) **Step 1: State the distribution and values of interest.** The length of pregnancies follows a Normal distribution with $\mu = 266$days and $\sigma = 16$ days. We are looking for the boundary value x that has an area of 0.20 to the right and 0.80 to the left (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for the value closest to 0.80. A z-score of 0.84 gives the closest value (0.7995). Solving $0.84 = \frac{x-266}{16}$ gives x = 279.44. *Using technology:* The command invNorm(area: 0.8, μ: 266, σ: 16) gives a value of 279.47. **Step 3: Answer the question.** The longest 20% of pregnancies last longer than 279.47 days.



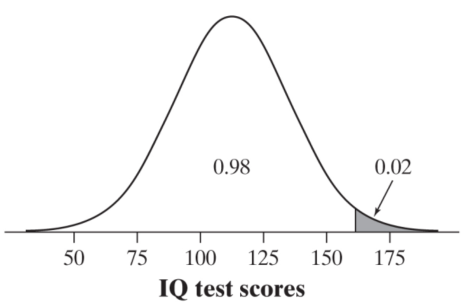
2.54 (a) **Step 1: State the distribution and values of interest.** For the 20 to 34 age group, IQ scores follow a Normal distribution with μ = 110 and σ = 25. We want the proportion of people who have scores less than 150 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{150-110}{25} = 1.6$. From Table A, the proportion of z-scores less than 1.6 is 0.9452. *Using technology:* The command normalcdf(lower: –1000, upper: 150, μ: 110, σ: 25) gives an area of 0.9452. **Step 3: Answer the question.** About 95% of people in this age group have IQ scores less than 150, so a score of 150 is at the 95th percentile.



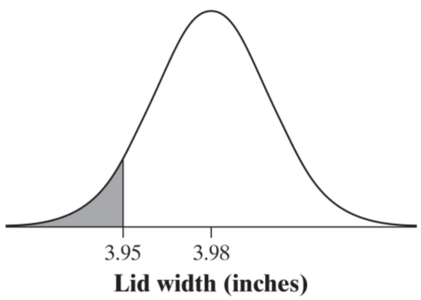
(b) **Step 1: State the distribution and values of interest.** For the 20 to 34 age group, IQ scores follow a Normal distribution with μ = 110 and σ = 25. We want the percent of people in this age group with IQ scores between 125 and 150 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized scores for the boundary values are $z = \dfrac{125-110}{25} = 0.6$ and $z = \dfrac{150-110}{25} = 1.6$. From Table A, the proportion of *z*-scores less than 1.6 is 0.9452 and the proportion of *z*-scores less than 0.6 is 0.7257. Thus, the proportion of *z*-scores between 0.6 and 1.6 is $0.9452 - 0.7257 = 0.2195$. *Using technology:* The command normalcdf(lower: 125, upper: 150, μ: 110, σ: 25) gives an area of 0.2195. **Step 3: Answer the question.** About 22% of 20 to 34 year olds have IQ scores between 125 and 150.



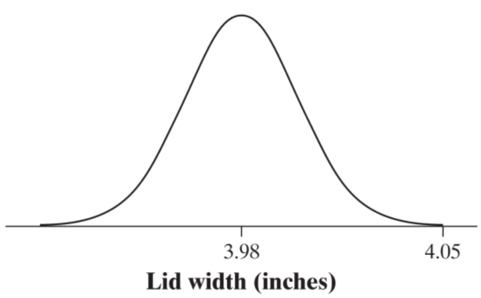
(c) **Step 1: State the distribution and values of interest.** For the 20 to 34 age group, IQ scores follow a Normal distribution with μ = 110 and σ = 25. We are looking for the boundary value *x* that has an area of 0.02 to the right and 0.98 to the left (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for a value closest to 0.98. A *z*-score of 2.05 gives the closest value (0.9798). Solving $2.05 = \dfrac{x-110}{25}$ gives *x* = 161.25. *Using technology:* The command invNorm(area: 0.98, μ: 110, σ: 25) gives a value of 161.34. **Step 3: Answer the question.** Scores greater than 161.34 qualify for MENSA.



2.55 (a) **Step 1: State the distribution and values of interest.** For large lids, the diameter follows a Normal distribution with mean 3.98 and standard deviation 0.02. We want to find the percent of lids that have diameters less than 3.95 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{3.95 - 3.98}{0.02} = -1.5$. From Table A, the proportion of z-scores below –1.5 is 0.0668. *Using technology:* The command normalcdf(lower: –1000, upper: 3.95, μ: 3.98, σ: 0.02) gives an area of 0.0668. **Step 3: Answer the question.** About 7% of the large lids are too small to fit.

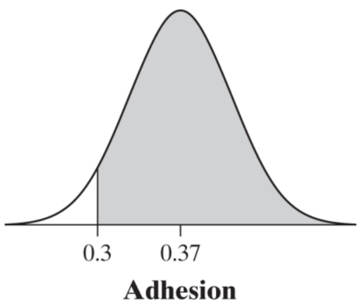


(b) **Step 1: State the distribution and values of interest.** For large lids, the diameter follows a Normal distribution with mean 3.98 and standard deviation 0.02. We want to find the percent of lids that have diameters greater than 4.05 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \frac{4.05 - 3.98}{0.02} = 3.5$. From Table A, the proportion of z-scores above 3.50 is approximately 0. *Using technology:* The command normalcdf(lower: 4.05, upper: 1000, μ: 3.98, σ: 0.02) gives an area of 0.0002. **Step 3: Answer the question.** Approximately 0% of the large lids are too big to fit.

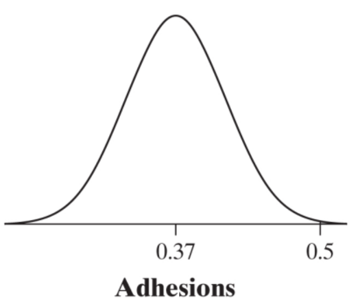


(c) It makes more sense to have a larger proportion of lids too small rather than too big. If lids are too small, customers will just try another lid. But if lids are too large, the customer may not notice and then spill the drink.

2.56 (a) **Step 1: State the distribution and values of interest.** The adhesion of a locomotive follows a Normal distribution with mean 0.37 and standard deviation 0.04. We want to find the proportion of days that the adhesion will be at least 0.30 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \dfrac{0.3 - 0.37}{0.04} = -1.75$. From Table A, the proportion of z-scores above −1.75 is $1 - 0.0401 = 0.9599$. *Using technology:* The command normalcdf(lower: 0.3, upper: 1000, μ: 0.37, σ: 0.04) gives an area of 0.9599. **Step 3: Answer the question.** The proportion of days that the locomotive will have an adhesion of at least 0.30 is 0.9599.



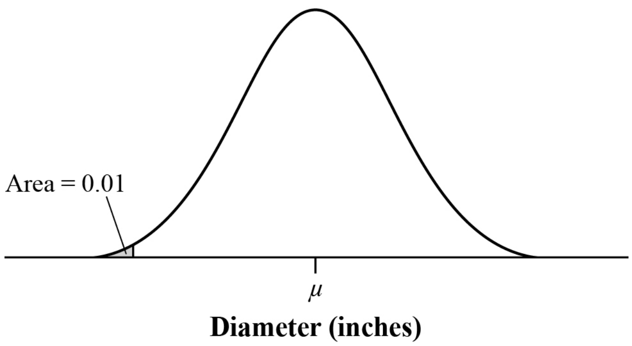
(b) **Step 1: State the distribution and values of interest.** The adhesion of a locomotive follows a Normal distribution with mean 0.37 and standard deviation 0.04. We want to find the proportion of days that the adhesion will be greater than 0.50 (see graph below). **Step 2: Perform calculations. Show your work.** The standardized score for the boundary value is $z = \dfrac{0.5 - 0.37}{0.04} = 3.25$. From Table A, the proportion of z-scores above 3.25 is $1 - 0.9994 = 0.0006$. *Using technology:* The command normalcdf(lower: 0.5, upper: 1000, μ: 0.37, σ: 0.04) gives an area of 0.0006. **Step 3: Answer the question.** The proportion of days that the locomotive will have an adhesion of greater than 0.50 is 0.0006.



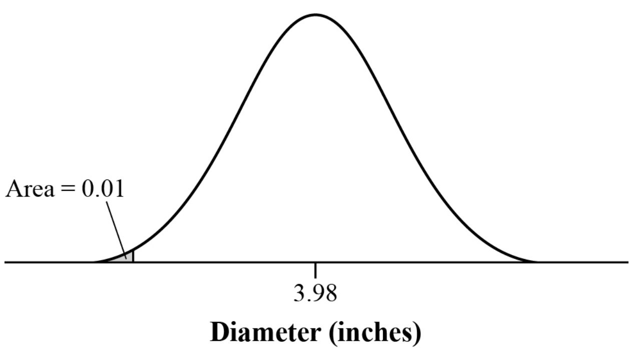
(c) It makes sense to try to have the value found in part (a) larger. We want the train to arrive at its destination on time, but not to arrive at the switch point early.

2.57 (a) **Step 1: State the distribution and values of interest.** For large lids, the diameter follows a Normal distribution with mean μ and standard deviation 0.02. We want to find the value of μ that will result in less than 1% of lids that are too small to fit (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for a value closest to 0.01. A z-score of −2.33 gives the closest value (0.0099). Solving $-2.33 = \dfrac{3.95 - \mu}{0.02}$ gives μ = 4.00. *Using technology:* The command invNorm(area: 0.01, μ: 0, σ: 1) gives z =

2.326. Solving $-2.326 = \dfrac{3.95 - \mu}{0.02}$ gives μ = 4.00. **Step 3: Answer the question.** The manufacturer should set the mean diameter to approximately μ = 4.00 to ensure that less than 1% of lids are too small.

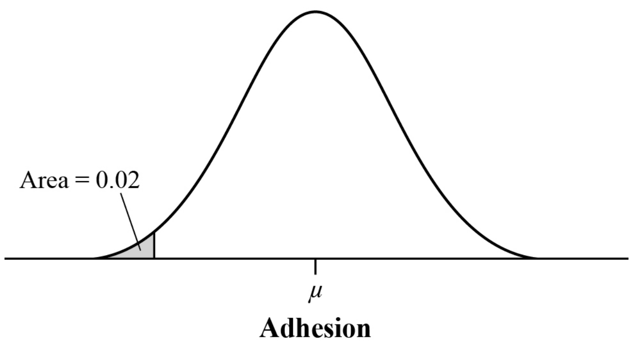


(b) **Step 1: State the distribution and values of interest.** For large lids, the diameter follows a Normal distribution with μ = 3.98 and standard deviation σ. We want to find the value of σ that will result in less than 1% of lids that are too small to fit (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for a value closest to 0.01. A *z*-score of –2.33 gives the closest value (0.0099). Solving $-2.33 = \dfrac{3.95 - 3.98}{\sigma}$ gives σ = 0.013. *Using technology:* The command invNorm(area: 0.01, μ: 0, σ: 1) gives$z$ = –2.326. Solving $-2.326 = \dfrac{3.95 - 3.98}{\sigma}$ gives σ = 0.013. **Step 3: Answer the question.** A standard deviation of at most 0.013 will result in less than 1% of lids that are too small to fit.

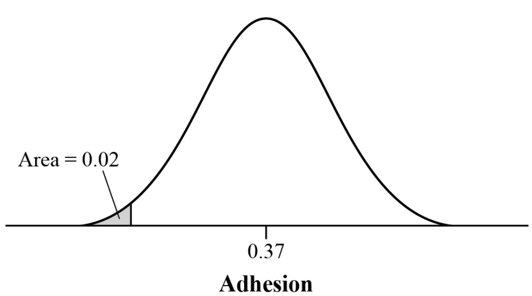


(c) We prefer reducing the standard deviation as in part (b). This will reduce the number of lids that are too small and the number of lids that are too big. If we make the mean a little larger as in part (a), we will reduce the number of lids that are too small, but we will increase the number of lids that are too big.

2.58 (a) **Step 1: State the distribution and values of interest.** The adhesion of a locomotive follows a Normal distribution with mean μ and standard deviation 0.04. We want to find the value of μ that will result in less than 2% of days with late arrivals (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for the value closest to 0.02. A *z*-score of –2.05 gives the closest value (0.0202). Solving $-2.05 = \frac{0.30 - \mu}{0.04}$ gives μ = 0.382. *Using technology:* The command invNorm(area: 0.02, μ: 0, σ: 1) gives $z = -2.054$. Solving $-2.054 = \frac{0.3 - \mu}{0.04}$ gives μ = 0.382. **Step 3: Answer the question.** The manufacturer should change the mean adhesion to approximately μ = 0.382 to ensure that the train arrives late less than 2% of days.

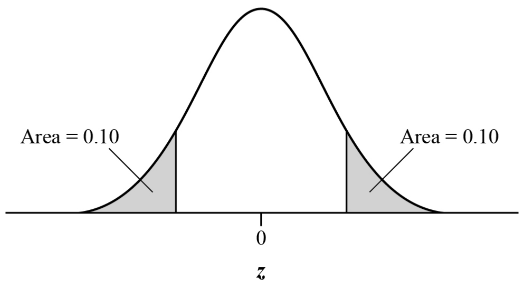


(b) **Step 1: State the distribution and values of interest.** The adhesion of a locomotive follows a Normal distribution with mean 0.37 and standard deviation σ. We want to find the value of σ that will result in less than 2% of days with late arrivals (see graph below). **Step 2: Perform calculations. Show your work.** Look in the body of Table A for a value closest to 0.02. A *z*-score of –2.05 gives the closest value (0.0202). Solving $-2.05 = \frac{0.30 - 0.37}{\sigma}$ gives σ = 0.034. *Using technology:* The command invNorm(area: 0.02, μ: 0, σ: 1) gives $z = -2.054$. Solving $-2.054 = \frac{0.3 - 0.37}{\sigma}$ gives σ = 0.034. **Step 3: Answer the question.** The standard deviation should be decreased to at most 0.034 to ensure that the train arrives late less than 2% of days.



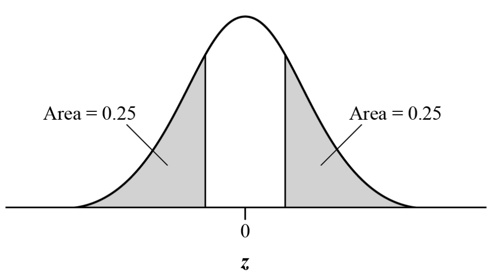
(c) We prefer reducing the standard deviation as in part (b). This will reduce the proportion of days that the train is late and the proportion of days that the train arrives early to the switch point. If we make the mean a little larger as in part (a), we will reduce the proportion of days that the train is late, but we will increase the proportion of days that the train arrives too early to the switch point.

2.59 (a) Using Table A, we are looking for the values of z that have areas of 0.10 and 0.90 to the left of z (see graph below). The value $z = -1.28$ has an area of 0.1003 to the left and the value $z = 1.28$ has an area of 0.8997 to the left. *Using technology*: The command invNorm(area: 0.10, μ : 0, σ : 1) gives $z = -1.282$ and the command invNorm(area: 0.90, μ : 0, σ : 1) gives $z = 1.282$.

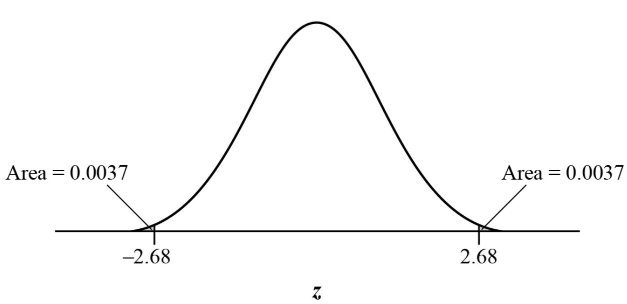


(b) Solving $-1.28 = \dfrac{x - 64.5}{2.5}$ gives x = 61.3 inches and solving $1.28 = \dfrac{x - 64.5}{2.5}$ gives x = 67.7 inches. The first decile is 61.3 inches and the last decile is 67.7 inches. *Using technology*: Solving $-1.282 = \dfrac{x - 64.5}{2.5}$ gives x = 61.295 inches and solving $1.282 = \dfrac{x - 64.5}{2.5}$ gives x = 67.705 inches. The first decile is 61.295 inches and the last decile is 67.705 inches.

2.60 To find the quartiles on the standard Normal distribution, we need to find the values of z that have areas of 0.25 and 0.75 to the left of z (see graph below).

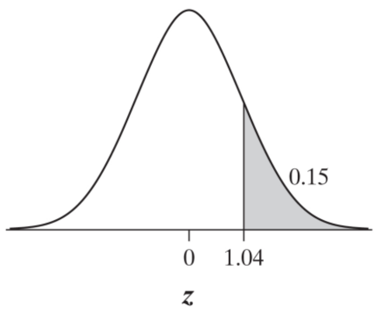


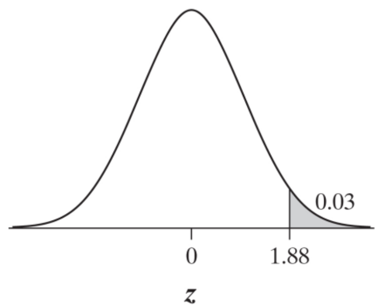
The value $z = -0.67$ has an area of 0.2514 to the left and the value $z = 0.67$ has an area of 0.7486 to the left. Thus, $Q_1 = -0.67$, $Q_3 = 0.67$, and $IQR = 0.67 - (-0.67) = 1.34$. Outliers are values less than $-0.67 - 1.5(1.34) = -2.68$ and greater than $0.67 + 1.5(1.34) = 2.68$. Finally, the area to the left of -2.68 is 0.0037 and to the right of 2.68 is $1 - 0.9963 = 0.0037$. Thus, the percent of values that are outliers is $0.0037 + 0.0037 = 0.0074 = 0.74\%$ (see graph below).



Using technology: The command invNorm(area: 0.25, μ : 0, σ : 1) gives Q_1 = –0.674 and the command invNorm(area: 0.75, μ : 0, σ : 1) gives Q_3 = 0.674. Thus, *IQR* = 0.674 – (–0.674) = 1.348. Outliers are values less than –0.674 – 1.5(1.348) = –2.696 and greater than 0.674 + 1.5(1.348) = 2.696. Finally, the command 1 – normalcdf(lower: –2.696, upper: 2.696, μ : 0, σ : 1) = 1 – 0.9930 = 0.0070. Thus, 0.70% are outliers.

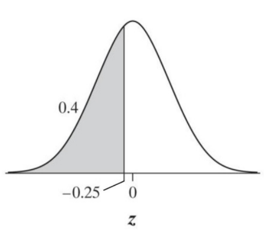
2.61 We are looking for the value of *z* with an area of 0.15 to the right and 0.85 to the left (see graph below, left) and the value of *z* with an area of 0.03 to the right and 0.97 to the left (see graph below, right). We get the values *z* = 1.04 and *z* = 1.88.

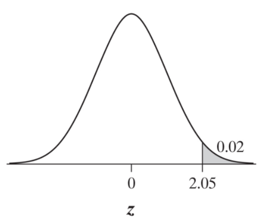




Now we need to solve the following system of equations for μ and σ: $1.04 = \dfrac{60-\mu}{\sigma}$ and $1.88 = \dfrac{75-\mu}{\sigma}$. Multiplying both sides of the equations by σ and subtracting yields $0.84\sigma = 15$ or $\sigma = 17.86$ minutes. Substituting this value back into the first equation we obtain $1.04 = \dfrac{60-\mu}{17.86}$ or $\mu = 60 - 1.04(17.86) = 41.43$ minutes.

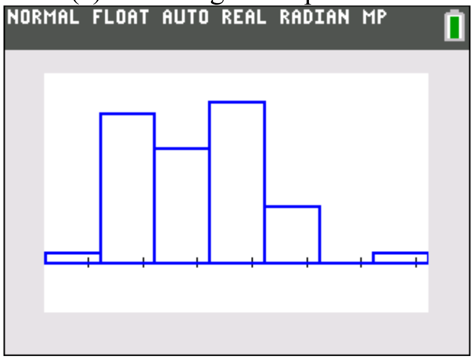
2.62 We are looking for the value of *z* with an area of 0.4 to the left (see graph below, left) and the value of *z* with an area of 0.02 to the right and 0.98 to the left (see graph below, right). We get the values *z* = –0.25 and *z* = 2.05.



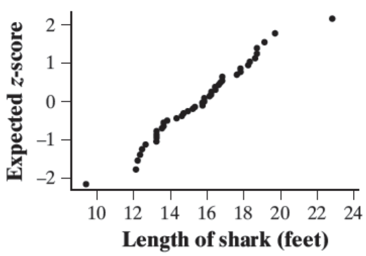


We need to solve the following system of equations for μ and σ: $-0.25 = \dfrac{1-\mu}{\sigma}$ and $2.05 = \dfrac{2-\mu}{\sigma}$. Multiplying both sides of the equations by σ and subtracting yields $-2.3\sigma = -1$ or $\sigma = 0.4348$ minutes. Substituting this value back into the first equation we obtain $-0.25 = \dfrac{1-\mu}{0.4348}$ or $\mu = 1 + 0.25(0.4348) = 1.1087$ minutes.

2.63 (a) A histogram is provided below.

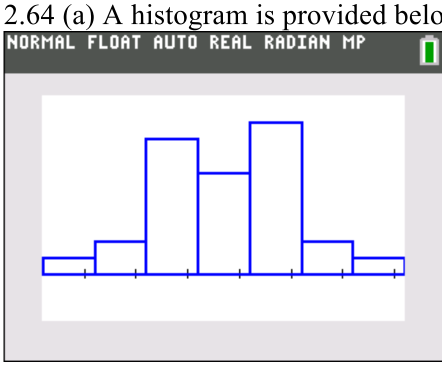


The distribution of shark lengths is roughly symmetric and somewhat bell-shaped with a mean of 15.586 feet and a standard deviation of 2.55 feet.
(b) 30/44 = 68.2% of the lengths fall within one standard deviation of the mean (13.036 to 18.136), 42/44 = 95.5% of the lengths fall within two standard deviations of the mean (10.486 to 20.686), and 44/44 = 100% of the lengths fall within 3 standard deviations of the mean (7.936 to 23.236). These are very close to the 68-95-99.7 rule.
(c) A Normal probability plot is shown below.



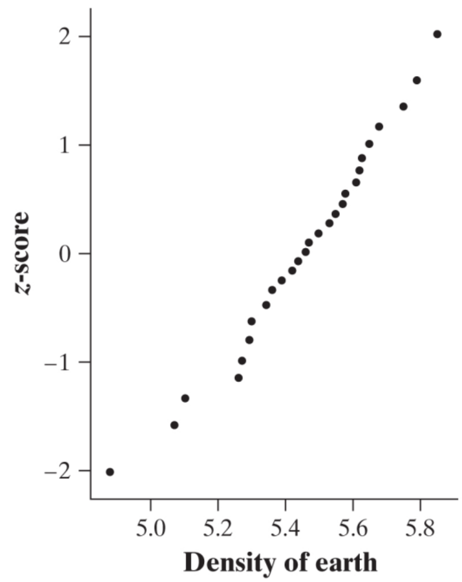
Except for one small shark and one large shark, the plot is fairly linear, indicating that the distribution of shark lengths is approximately Normal.
(d) The graphical display in (a), check of the 68−95−99.7 rule in (b), and Normal probability plot in (c) all indicate that shark lengths are approximately Normal.

2.64 (a) A histogram is provided below.



The measurements of the earth's density are roughly symmetric, single-peaked, and somewhat bell-shaped with a mean of 5.45 and a standard deviation of 0.2209.
(b) 22/29 = 75.86% of the densities fall within one standard deviation of the mean (5.2291 to 5.6709), 28/29 = 96.55% of the densities fall within two standard deviations of the mean (5.0082 to 5.8918), and 29/29 = 100% of the densities fall within 3 standard deviations of the mean (4.7873 to 6.1127). The densities follow the 68−95−99.7 rule reasonably well.

(c) A Normal probability plot is shown below.



The Normal probability plot is roughly linear, indicating that the densities are approximately Normal.
(d) The graphical display in (a), the 68-95-99.7 rule in (b), and the Normal probability plot in (c) all indicate that these measurements are approximately Normal.

2.65 The distribution is close to Normal because the Normal probability plot is nearly linear. There is a small "wiggle" between 120 and 130 with several values a little larger than would be expected in a Normal distribution. Also, the smallest value and the two largest values are a little farther from the mean than would be expected in a Normal distribution.

2.66 The sharp curve in the Normal probability plot suggests that the data are right-skewed. This can be seen in the steep, nearly vertical section in the lower left. These numbers were much closer to the mean than would be expected in a Normal distribution, meaning that the values that would be in the left tail are piled up close to the center of the distribution.

2.67 The distribution of tuitions in Michigan is not approximately Normal. If it was Normal, then the minimum value should be around 2 or 3 standard deviations below the mean. However, the actual minimum has a *z*-score of just $z = \dfrac{1873 - 10{,}614}{8049} = -1.09$. Also, if the distribution was Normal, the minimum and maximum should be about the same distance from the mean. However, the maximum is much farther from the mean (30,823 – 10,614 = 20,209) than the minimum (10,614 – 1873 = 8741).

2.68 The distribution of women's weights is skewed to the right. In a Normal distribution, Q_1 and Q_3 should be about the same distance from the median. However, the distance from Q_1 to the median (133.2 – 118.3 = 14.9) is smaller than the distance from the median to Q_3 (157.3 – 133.2 = 24.1).

2.69 b

2.70 c

2.71 b

2.72 b

2.73 a

2.74 d

2.75 For both kinds of cars we see that the highway miles per gallon is higher than the city miles per gallon, a conclusion that we would have expected. The two-seater cars have a wider spread of miles per gallon values than the minicompact cars do, both on the highway and in the city. Also the miles per gallon values are slightly lower for the two-seater cars than for the minicompact cars, both on the highway and in the city, with a greater difference on the highway. All four distributions are roughly symmetric.

2.76 (a) The two-way table is shown below.

	Cold	Neutral	Hot	Total
Hatched	16	38	75	129
Not hatched	11	18	29	58
Total	27	56	104	187

(b) The percent of eggs in each group that hatched are 16/27 = 59.26% in a cold nest, 38/56 = 67.86% in a neutral nest, and 75/104 = 72.12% in a hot nest. The data support the belief that the percent hatching increases with temperature.